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Interactive comment on “Effects of nitrogen fertilization on the understorey carbon balance over the growing season in a boreal Pine forest”

by D. B. Metcalfe et al.

Anonymous Referee #3

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The manuscript by Metcalfe et al investigates the role of understorey vegetation in the shifts of the C balance in boreal forest following long-term N addition. The topic is of interest as understorey vegetation has been shown to contribute significantly to C assimilation (as well as respiration), and a number of studies in recent years have shown significant changes in forest C allocation following N fertilisation. Understanding the relative contributions of trees and different understorey species would allow a better projection of likely impacts of N deposition and climate change impacts on future C sequestration in these forests.

I have some problem with the experimental design of the study. There is ample replication of flux measurements within three areas of different N fertilisation (control and

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two N addition levels). This means that the main treatment (N addition) is not truly replicated, but rather that a large number (17) of sub-replicates are used for statistical analysis. I could not see any evidence that the plots were otherwise comparable prior to N addition was started, which is critical here.

More significantly still, the approach fails to separate understorey gas exchange from tree root fluxes. N addition will have impacted the tree C allocation and hence below-ground respiratory flux (see citations in the manuscript on this, mainly from the Hogberg group). By measuring net gas exchange and light response in these plots, a variable amount of C from tree roots is part of the measured response. I was surprised that throughout the manuscript all fluxes (assimilation and respiration) are interpreted as understorey fluxes only, when clearly the net C sink/source terms can only be obtained once the tree effect has been removed. As tree belowground allocation of C is a significant component of total CO₂ flux and also seasonably variable, I find it impossible to draw any conclusions regarding the understorey C balance from data shown in Fig. 2, and interpreting flux differences as “plant carbon surplus” as in Fig. 3 is misleading. In the absence of any partitioning (why no trenching to exclude tree roots in plots???), I do not think that the conclusions are safe, and unfortunately conclude that a rejection of the manuscript is appropriate.

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